P.S. Bond, The Clausewitz of Combat Engineering: Does Assured Mobility Follow His Principles?

A Monograph
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AY 02-03

SCHOOL OF ADVANCED MILITARY STUDIES

MONOGRAPH APPROVAL

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Title of Monograph: P.S. Bond, The Clausewitz of Combat Engineering: Does Assured Mobility Follow His Principles?

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Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **22 MAY 2003**	2. REPORT TYPE	3. DATES COVERED -
4. TITLE AND SUBTITLE **P.S. Bond, the Clausewitz of combat engineering: does assured mobility follow his principles?**		5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S) **Robert Butts**		5d. PROJECT NUMBER 5e. TASK NUMBER 5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **US Army School for Advanced Military Studies,250 Gibbons Ave,Fort Leavenworth,KS,66027**		8. PERFORMING ORGANIZATION REPORT NUMBER **ATZL-SWV**
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S REPORT NUMBER(S)
12. DISTRIBUTION/AVAILABILITY STATEMENT **Approved for public release; distribution unlimited**		
13. SUPPLEMENTARY NOTES **The original document contains color images.**		

14. ABSTRACT

Doctrine developers in the combat arms often draw upon the wisdom of military theorists like Clausewitz, Jomini, JFC Fuller and BH Liddell Hart. While these theorists provide enduring wisdom on operational art, their work lacks detail regarding many of the battlefield operating systems (BOS). As a combat arm, engineers draw upon the same principles of operational art as the maneuver arms. As maneuver support specialists, engineers must also adhere to principles that are branch specific. Unfortunately, most of the available written material on military engineering, other than Army doctrinal manuals, can only be classified as tactics, techniques and procedures. There is very little material available to describe the operational art of military engineering or what its enduring concepts are. Research on this topic revealed one author whose concepts stood out. His work illustrated the elemental principles of military engineering - much as Clausewitz and Jomini described the fundamental principles of war. That author was Colonel Paul Stanley (P.S.) Bond. Bond commanded a US Army engineer regiment in Word War I and wrote about his experiences until the mid 1950s. It is evident in his writings that he had a thorough understanding of military engineering and its application on the battlefield. He also had a keen understanding of general military tactics and operational art and published many works on these subjects as well. As the Army moves towards transformation, the plans being developed currently aim to radically alter engineer organization and employment. The Objective Force will depend heavily upon mobility but will employ the mobility and survivability BOS in a manner that is completely different from current doctrine. When adopting changes in this manner it is both desirable and prudent to draw upon enduring and proven principles. The central argument that Bond makes throughout his writings is that capable people are the essential element of any combat formation. Weapons and equipment, no matter how advanced, are simply tools. People determine the success or failure of the Army. This monograph examines Colonel Bond's writings and compares his principles of military engineering to the current Objective Force Proposals, which are centered around the concepts of "assured mobility" and "embedded capabilities". The analysis attempts to reveal whether or not "assured mobility" is based upon sound historical and doctrinal foundations. Using this limited yet proven model the monograph highlights potential risks and shortfalls with the emerging doctrine and makes recommendations to minimize or correct them.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**1**	**52**	

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Research on this topic revealed one author whose concepts stood out. His work illustrated the elemental principles of military engineering – much as Clausewitz and Jomini described the fundamental principles of war. That author was Colonel Paul Stanley (P.S.) Bond.

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CHAPTER ONE

Introduction

Predicting future military requirements has never been a straightforward task. The thinking enemy comprises a complex, adaptive system of systems. This thinking enemy will always try to negate our advantages, seek his own and achieve victory.[1] Many of the great commanders of history such as Gustavus Adolphus, Frederick The Great, and Napoleon succeeded partly because they organized their forces to get the most from the available technology. They leveraged the technological advances of the time by applying sound military principles and employed superbly trained soldiers in innovative ways to achieve or enhance this technological overmatch.[2] In effect, these commanders used the technology to adapt to the situation faster than their enemies did; or they forced their opponents to try to adapt more quickly than these enemies were capable of.[3]

In the current information age it is difficult (if not impossible) for military doctrine to keep pace with technology. But students of military history understand that many historical concepts are enduring. Many military officers agree that while the means and materiel of war may change over time certain key principles of war do not. Most military professionals who have studied the great theorists will also agree that there is still something to learn from the writings of Sun Tzu, Clausewitz, J.F.C. Fuller, B.H. Liddell Hart and others.

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[1] Grau, Lester W., "Bashing the Laser Range Finder With a Rock." *Military Review*, May-June 1997, [article on line]; retrieved 2 December 2002 from < http://call.army.mil/fmso/fmsopubs/issues/techy.htm

[2] Rothenberg, Gunther E., *The Art of Warfare in the Age of Napoleon.* (Bloomington: Indiana University Press, 1978), 71-80

[3] Phillips, T.R., Brig. Gen. (Ed.), "The Instruction of Frederick The Great for His Generals", *Roots of Strategy,* Volume I. (Mechanicsburg, PA: Stackpole Books, 1985), 303-310

Fuller and Liddell Hart are of special significance to the study of contemporary military theory because of their contributions to combined arms principles and the concepts of mobile, mechanized warfare. Though their theories are nearing one hundred years old, they expressed ideas that were arguably among the foundational concepts of our current combined arms doctrine. They certainly influenced German mechanized and armored doctrine in World War II.[4] In his seminal work, *The Foundations of the Science of Warfare*, JFC Fuller clearly laid out principles of mechanized warfare that are still followed today. Fuller's visions for using combined arms maneuver helped usher in a new age in warfare.[5]

For all of their wisdom, the writings of Fuller and Liddell Hart have surprisingly scant detail regarding the disciplines of combat engineering or the employment of engineers on the battlefield. Despite the long-term historical significance of combat engineering and the masterful employment of mobility, countermobility and survivability by commanders like Napoleon, few commonly studied military theorists seem to have devoted much time writing about it. There are a few notable exceptions. French military engineer Sebastien Le Prestre de Vauban has long been recognized as the father of modern military fortifications.[6] From its early days, the U.S. Military Academy at West

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[4] Blumenson, Martin. "Kasserine Pass, 30 January-22 February 1943." *America's First Battles: 1776-1965.* (Lawrence: University of Kansas Press, 1986), 231-232

[5] Fuller, J.F.C., *The Foundations of the Science of War* (London: Hutchinson & CO. [Publishers], LTD., 1926. Reprint, Fort Leavenworth: US Army Command and General Staff College Press, 1993), 81-85

[6] "Vauban, Sebastien Le Prestre de."[article on line]; retrieved 10 December 2002 from <http://viking.gmu.edu/http/projects/Vauban/vauban.html;
"Vauban", *The 1911Edition Encyclopedia* [On-Line Encyclopedia Resource]; retrieved 10 December 2002 from < http://25.1911encyclopedia.org/V/VA/VAUBAN_SEBASTIEN_LE_PRESTRE_DE.htm and, "Sébastien Le Prestre de Vauban" [article on line]; retrieved 10 December 2002 from <http://www.structurae.de/en/people/data/des1180.php

Point was primarily a school of engineering. At West Point generations of US Army officers learned techniques based upon principles that Vauban developed.[7]

Though Vauban's work may certainly be considered the very foundation of modern military engineering, the techniques he developed cannot be regarded as enduring as the ideas of military theorists like Clausewitz. One reason for this is that military engineering, like all other engineering, is inexorably tied to technology. Just as improvements in building materials allow larger, taller buildings vast improvements in weapons systems quickly rendered obsolete the fortifications that Vauban perfected in 1658.[8]

The student and scholar of military engineering is left in search of a theorist who encapsulated the basic, timeless concepts of mobility and survivability; a theorist whose ideas transcend technological advances as Clausewitz's do. Few military professionals may know it today but our own United States Army may have produced such a theorist. He was a man who not only distilled the essence of military engineering and applied it effectively in battle, but was also a man who understood the American way of warfare. He developed his principles to fit our unique military style. That man was Paul Stanley (P.S.) Bond.

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[7] Hephner, Richard, H., "Decline of the Assault: 1830-1865", [On the Fire-step on line (Fairfax, VA)]; retrieved 11 December 2002 from < http://www.fire-step.com/assault.html

[8] Hephner, Richard, H., "From Castles to Cannons: The Middle Ages to 1830", [On the Fire-step on line (Fairfax, VA)]; retrieved 11 December 2002 from < http://www.fire-step.com/castle.html

Even before J.F.C. Fuller penned his influential work, *The Foundations of the Science of War*, his American contemporary, P.S. Bond, was contemplating how to employ engineers on the battlefield. Bond was a career army engineer officer. His service at the end of the nineteenth century molded him into a master of military engineering. At this time the Corps of Engineers was putting the finishing touches on westward expansion and young engineer officers were busy mapping and surveying the west and building the nation's vital infrastructure. Bond was a prolific military writer until his death in 1955. Besides several books on tactics and military science, he wrote countless technical articles for both civilian and military engineering publications. Upon reading his work and comparing it to other writings of the time it becomes clear to the reader that he is among the founders of our modern combined arms doctrine. Many of his ideas seem to have found their way into contemporary military manuals. Whether Bond was the originator of those ideas or simply the one putting them in print is irrelevant. What is significant is that from the beginning of World War I to the Beginning of World War II Bond was among the most widely published authors of works on US Army doctrine and tactics. [9] This period is recognized by many as a turning point in military history. Writers like Fuller and Liddell Hart are often given credit for many of the innovations resulting from this period. Though he is not as well known, P.S. Bond was certainly an innovator as well.

When it became apparent that the US would be drawn into World War I Bond expressed deep concerns at the state of our engineer corps and developed a plan to recruit

[9] P.S. Bond published or edited over a dozen books on military doctrine and tactics between 1916 and 1942. Some of his works such as, *Essentials of Infantry Training* (Harrisburg, PA: The Military Service Publishing Company, 1942.) and *Tactics: The Practical Art of Troop Leading* (New York: The American Army and Navy Journal, Inc., 1922) were adopted by the Army as standard textbooks for officer training.

and train soldiers and leaders with vital engineering skills. Bond published *The Engineer in War* in 1916 and established what he believed were the critical requirements and capabilities for engineer units, soldiers and leaders. His book was aimed at educating *civilian* engineers, contractors and construction workers (persons already skilled in civil engineering) to quickly transition to the role of *combat* engineers and fill the critical void in US capability at that time.[10] Bond expressed what he called "concepts for employing engineer units with combat formations" and detailed what he believed were the key employment concepts and core competencies of this combat arm.[11]

His concepts are very simple (the book is under 200 pages long) but they attempt to encapsulate the root ideas of combat engineering. They consider the technology of the period, and Bond devotes a few chapters to describing detailed techniques for using this technology, but Bond's real strength is his ability to grasp and articulate timeless concepts.

The Army employed engineers in World War I exactly as Bond prescribed. The fields and trenches of "The Great War" validated most of his concepts. Like most competent officers of the day, Bond quickly rose in rank and gained more responsibility. At the beginning of the war he had recently graduated from the Army Staff College (after previously being named the honor graduate of his Engineer School class). By the war's

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[10] Bond, P.S., *The Engineer in War* (New York: McGraw-Hill Book Company, Inc., 1916), Preface vii-viii., 1-11

[11] Ibid. 12-13

end he had commanded the 107th Engineer Regiment, 32nd Division and served in key roles on General Pershing's staff.[12]

During the interwar years Bond wrote or co-authored numerous works on a variety of military subjects. Many of these works were incorporated into the "Field Service Regulations" - the US Army's doctrine at the start of World War II. Despite his background as an engineer he was a noted authority on infantry and combined arms doctrine and, more specifically, an expert on training and leader development. Bond was a firm believer in the US concept of "the citizen soldier" and devoted much effort to improving and standardizing Army R.O.T.C.[13]

Careful examination of Bond's concepts (for employing engineers) through the lens of history makes it apparent that there is something deeper to them – something which transcends the period for which they were developed. Historical evidence from World War II consistently indicates that, when engineers were employed in the manner that Bond prescribed, the US Army usually met with battlefield success. Evidence from later conflicts, from Korea through Bosnia, illustrates that we adopted principles either similar or identical to the ones Bond wrote about for the employment of engineer forces. Even if P.S. Bond is not the true founder of our engineer doctrine he certainly adapted the body of knowledge to fit our way of warfare and established a set of principles that capture the essence of it. It must be made clear that *The Engineer in War* is not a rigid, prescriptive manual. Bond's concepts, like those of Clausewitz, are dispersed throughout

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[12] "Organization of the 32nd Division: When it was Created, During World War I in 1917" [article on line]; retrieved 5 December 2002 from< http://www.e-2-127.org/history/ww1/32ww1org.html and, Stonehouse, Frederick, "The History of the 107th Engineer Battalion (1881-1981) [article on line]; retrieved 12 January 2003 from < http://www.107thengineers.org/History/CombatEngineer/bookframe.html

[13] Bond, P.S. and Garey, O.O., *The R.O.T.C. Manual: A Textbook for the Reserve Officers Training Corps*, 4 Volumes (Baltimore: The Johns Hopkins Press, 1921)

his writings and complement the tactics and operational art that they support. Bond's writing style makes his key principles clearly stand out though they are not presented in checklist form. His work distills the basic principles of military engineering into their most elemental form – a form that seems to fit despite the battlefield conditions or the ways and means available. From his impressive body of work it is also clear that he understood doctrine and training. Because of this, his principles are clear, concise and insightful.

What seems to make Bond's work enduring (and potentially valuable to modern military study) is that, while he saw war as mostly just another engineering problem, he also understood war's inherent complexity and he tailored his principles to deal with this complexity. Unlike many writers (especially engineers) it seems he clearly understood and expressed that all military problems couldn't be solved by only the application of scientific principles. In effect his approach to warfare follows that of Clausewitz more closely than it does Jomini.

So why are P.S. Bond's writings relevant today? The current Army transformation initiatives will represent dramatic changes in the way we organize, equip and employ forces. The upcoming changes in mobility and survivability doctrine and engineer organization and employment are some of the most far-reaching changes in the entire objective force concept. As the Army goes through the process of reinventing how it conducts operations and develops new concepts to do this it is prudent to draw upon the enduring lessons of history to support these new ideas. It is also vitally important to base change upon fundamental, enduring and proven principles. These principles should not just address how we should fight but should also examine *what we*

should be. The maneuver arms have done this in great detail with the works of Clausewitz, Jomini, etc. These writers define the essence of what a soldier should be and what makes him valuable to the nation. P.S. Bond attempted to do the same thing for combat engineers. The engineer regiment should consider the principles of P.S. Bond as a litmus test for any new doctrine.

This monograph explores Bond's principles. It first attempts to establish a baseline by defining military engineering and military engineers. It next explores what military engineering is, how it differs from all other engineering and what comprises it in an effort to determine its essential elements. It also illustrates what makes military engineers different from their civilian counterparts. This is an attempt to determine what characteristics we need to obtain and develop in military engineer personnel. Next, it examines what P.S. Bond prescribed as the duties of engineer troops in support of maneuver forces. It analyzes what Bond wrote and looks at historical examples that prove the validity of his writings. From there it examines the emerging Army concept of Assured Mobility and the objective force organizations built around this concept. Do they fit the concepts that Bond prescribed? Where do they differ? Finally, it concludes with recommendations on implementing Assured Mobility and objective force organization to best fit the enduring historical principles that we find. It points out risks and benefits associated with disregarding historical experience in favor of new and innovative methods.

CHAPTER TWO

What Is Military Engineering?

Military vs. Civil Engineering

A search for the key principles of military engineering must begin with the definition of what military engineering is. Military engineering in a general sense is the adaptation of civil engineering to the conduct of war.[14] It is however a unique and special application of the engineering arts and sciences. Its methods and economics are essentially different from those that characterize civil engineering.

Engineering Defined

The essence of engineering and what engineers do is not common knowledge. Even the most elementary principles, upon which our very lives depend, like the construction of highway bridges, jumbo jets or cars, are totally alien to many people. Yet as noted author and engineering professor Henry Petroski stated in his book, *To Engineer is Human*, "the ideas of engineering are in fact in our bones and part of our human nature and experience." According to Petroski engineering incorporates both art and science. The goal of the engineer it to create something (possibly something that has never been created before) and to do so with elegance and economy.[15] For example, structural engineering is the art and science of designing and making buildings, bridges,

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[14] Bond - *The Engineer in War*, 11

[15] Petroski, Henry, *To Engineer is Human: The Role of Failure in Successful Design* (New York: Random House Vintage Books, 1992), 40

frameworks and other similar structures that can safely resist the forces to which they may be subjected and to make them as economically and elegantly as possible.[16]

Engineering like war involves both art and science.

Economy is a key component of engineering and the balance between functionality, safety and economy is a critical one that constantly tests the skills and knowledge of the engineer.

Finding and maintaining this balance is the key problem for and duty of any engineer. The engineer accomplishes his task primarily by *reductionist*, scientific methods. He reduces the complex, non-linear "real world" to a mathematical model and builds his creation from this model. Though the model doesn't truly reflect reality it is usually "close enough" to produce whatever the engineer is trying to build. The *art* of engineering is knowing when this approximation is close enough to safely give maximum utility and economy.[17]

Because it involves both art and science engineering has many similarities to military theory and practice. Like the engineer the military commander or planner must maintain the delicate balance between effectiveness, safety and economy. P.S. Bond said that, "engineering plays so important a role in all the operations of warfare that it is perhaps no exaggeration to say that modern war is an application of engineering science to the armed conflicts of states."[18] Arguably, the military commander, regardless of branch or arm of service, is a type of engineer - but not, by definition, a combat engineer.

[16] Petroski, 41
[17] Ibid
[18] Bond - *The Engineer in War*, vii

The combat engineer vs. the civil engineer

The combat engineer does not exist fundamentally to "engineer violence" - though as a member of the combat arms he can do so when required. The role of the combat engineer is primarily to facilitate, enable or aid military operations. This fundamentally *supporting* role to the maneuver forces makes the combat engineer's job very similar to that of his civil engineer counterpart. The primary difference is that while civil engineers focus on building elegant and *enduring* structures, combat engineers deal mostly with "quick and dirty" expedients, makeshifts and improvisations. Bond said, “the combat engineer does not build for posterity. He works for the exigency of the moment.”[19] As the army arrives at the impassable stream the combat engineer rapidly scans the unique situation and, using available resources, training and skills, overcomes the obstacle. In this way combat engineers become the agents that keep the complex, adaptive system (the army) from drifting to equilibrium or descending into chaos.

In order to function effectively the military engineer must possess not only a thorough knowledge of construction but also a thorough knowledge of the art of warfare. He must anticipate the needs of the army and work to meet those needs. The engineer leader must be, first and foremost, a soldier and a student of combined arms tactics and operational art.

Engineering and Complexity

The inherent complexity of the battlespace means that the situation and the needs of the army are always changing. Ironically, the military engineer must rely upon

[19] Ibid. 10-13

simplicity to adapt quickly and continuously to this change.[20] Military engineers are historically masters of the complex battlespace because of their ability to rapidly adapt and build simple solutions that meet immediate tactical needs - but rarely anything more[21]. Their success is based upon their methods of engineering. These methods are a perfect fit for the turbulent environment of battle.

> ***"The highest expression of the skill of the military engineer is this very simplicity, and the rapid adaptation of his designs to the tactical requirements of the situation and to the resources in men, tools, materials and time at his disposal."***
> ***- P.S. Bond, <u>The Engineer in War</u>***

The designers of the Objective Force apparently believe that applying more advanced technology will allow the Army to overcome much of the complexity of warfare. One example of this is the proposal to “embed" some military engineering capabilities into the objective combat vehicle. The goal is to eliminate the need for trained soldiers to accomplish essential mobility and survivability missions. This will not only reduce the size of the force but also (in theory) the logistical requirements associated with maintaining “specialist troops”.[22] The civil engineering world has gone through a similar thought process for nearly the past three decades. Because of the complexity of engineering and the substantial amount of expense and time it takes to train engineers, the industry has sought to leverage technology and subsequently reduce the number of highly-trained people needed to plan and design structures.

[20] Ibid. 13
[21] Ibid
[22] US Army Training and Doctrine Command, TRADOC Pamphlet 525-3-90/O&O, *The United States Army Objective Force: Operational and Organizational Plan for the Maneuver Unit of Action* (Ft Monroe, VA, US Army TRADOC, 2002), 145-168

Automation has certainly enabled engineers to design and build more complex and economical structures, but it has created pitfalls as well. In his book, *To Engineer is Human,* Henry Petroski called this "the misuse of computers".[23] Computers can be programmed to attack problems in structural analysis that would never have been attempted by men and women wielding only slide rules. The result is often incredibly complex yet very elegant and economical structures. The problem is that the mathematical data defining these structures does not *completely* and accurately represent reality. One small oversimplification or outright flaw in the data can have catastrophic results. The computer must still rely upon a human to understand the system and ask the right questions. Given the geometric increase in complexity that the computers themselves produce it has become increasingly unlikely that any one human engineer can anticipate and ask the machine all the right questions. The computer is both a blessing and a curse. It makes calculations possible beyond the realm of human endurance while at the same time making them virtually beyond hope of human verification.[24] This phenomenon was partially to blame for the 1981 collapse of the Hyatt Regency walkways in Kansas City that killed over one hundred people.[25] Even if someone thinks of all the critical questions, and can phrase them so that the computer can accurately model them, a human must still decide whether or not to act on the machine's data. With fewer humans on the job in an ever increasingly complex environment it is increasingly likely that flaws will go unnoticed. Yet humans must still be relied upon do something machines are incapable of. They must use *judgement.*

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[23] Petroski, 197
[24] Ibid. 197-198
[25] Ibid. 196

Humans continue to be the most reliable agents for dealing with complexity and the reliability they provide continues to offset their cost. The civil engineering community has come to recognize this and has ensured that legislation and professional engineering certification is changed to keep pace with the requirements.

If we apply this logic to military engineering it is difficult to imagine an "embedded system" that can deal with the shear complexity of the modern or future battlespace. We will still need humans to ask the right questions and exercise judgement. Those humans must have a sound understanding of the *military* as well as the engineering requirements though training, study and experience. The enlisted infantryman driving the objective combat vehicle (or even his platoon leader) should never be expected to have the knowledge or experience to exercise sound judgement when faced with a complex engineering problem. Conversely, even with the miracle of "reach back" provided by advanced technology, the skilled technician back in the laboratory cannot have the same fidelity of situational awareness that the soldier in the objective combat vehicle has; nor can he be expected to be an expert in military art and science. To find a balance between these extremes we will still need experts on the ground. Those experts, even if they are just specially trained infantrymen, will be combat engineers.

Qualities of the Ideal Engineer Soldier and Leader

According to P.S. Bond the ideal engineer officer of World War I should be "a man of high professional qualifications both as a soldier and as an engineer. Without such qualifications an engineer officer cannot properly plan nor execute the varied works

assigned to him, nor can he properly subordinate his work to the needs of the combatant forces."[26] As we approach this period of relative uncertainty we should continue to follow Bond's prescription for engineer officers. To deal with the profound complexity of the modern and future battlespace we must select and train leaders who are competent soldiers and have a broad knowledge of the engineering challenges they are likely to face. Bond goes on to say that the ideal military engineer should be "an all-around man who can turn his hand to anything".[27] Bond recognized the complexity of military engineering and wanted men with broad knowledge and experience, "upon which the nation relies and to whom specialists become tools in his hands."[28] He recognized the need for people with specialized skills in the army but maintained, "they would be of limited value with an army in contact with the enemy". Their internal models are too rigid. Their ability to adapt quickly to the complex environment is too limited. Today we ask much of our engineer soldiers and leaders. Few branches in the Army face more challenges within the context of a single operation than the engineer regiment. Given the current operating environment, the same unit that must be expert in combined arms breaching must be able to transition rapidly to rough vertical or horizontal construction. The sapper who operates a mine detector one day may be constructing tent pads or repairing runways the next. Contemporary engineer operations are typically ad hoc, joint, combined and interagency. They often involve both military and civilian elements. Engineers are

[26] Bond - *The Engineer in War*, 17
[27] Ibid
[28] Ibid

expected to be troop leaders, diplomats, financiers, moralists and stewards of the environment.[29]

The reality of 2003 requires an engineer to be "the all-around man" (or woman) just as much as it did in Bond's day.

CHAPTER THREE

Duties of Engineer Troops with the Mobile Army

Engineers are a combat arm that enable joint and maneuver commanders to achieve their objectives through strategic movement and tactical maneuver. They accomplish this by providing unique combat engineering, geospacial engineering and general engineering capabilities. No matter how many of these capabilities are embedded in combat systems it is still just as it has always been in the US Army; the responsibility of the engineer soldier to identify and overcome any shortfalls or unforeseen problems that inhibit strategic movement or tactical maneuver.[30]

The principles and tenets for the organization, training and employment of engineers are, like all other doctrine, based upon experience, historical lessons, and experimentation. In order to develop new principles or alter existing ones it is necessary to develop a hypothesis and to test it using these basic methods. Of course the true test of any hypothesis on war will come on the future battlefield but experience, history and

[29] Toomey, Christopher J., "The Adaptive Engineer Leader", *Engineer: The Professional Bulletin of Army Engineers* (Washington, DC, US Government Printing Office, May 2001), 49-51
[30] US Army, Field Manual 3-34, *Engineer Operations (Draft)* (Washington, D.C.: Department of the Army, 2002 [final TBP 2003]), 4

experimentation can serve as a guide to determine the probable success of a given method.

The previous chapter delved into the roots of combat engineering. The goal was to define what military engineering is at its base and how it relates to and differs from civil engineering. It also briefly examined the basic nature of engineer soldiers. It looked for the key qualities and attributes required of both using P.S. Bond's hypothesis from 1916 as a model.

> *"The Engineers have hairy ears,*
> *they live in caves and ditches,*
> *But when the trouble starts,*
> *they fight like sons of witches"*
> *- An Anonymous WWI Soldier*

This chapter explores Bond's tenets of military engineering in greater detail. The focus will be on what he wrote about engineers in support of maneuver forces. With the benefit of hindsight provided by nearly ninety years of history it will assess the value of Bond's work and extract the enduring tenets of military engineering. If we can prove that these principles have stood the test of time, we can apply them to test the current hypotheses that aim to change US Army engineer doctrine.

<u>Bond's First Principle</u> -"Engineer operations should be integrated to facilitate the rapid movement of combatant forces."

P.S. Bond wrote that, "duty with the mobile army is the prime function of engineer troops, and is the one on which their organization, training and equipment

should be primarily based."[31] At the start of World War I the US had only a handful of engineer troops. Spurred by the efforts of P.S. Bond and others the National Defense Act of 1916 reorganized the engineer corps. A determined effort was made to integrate engineer units into tactical formations. The result contributed to an overwhelming success for US forces. The history of the engineer regiments in the fighting divisions is closely woven into the story of the divisions themselves.[32] Not only did engineer units prepare many of the massive fortifications and entrenchments in this largely defensive war they also did their share of the fighting and suffered a significant portion of the battle casualties. Though engineers fought as infantry in virtually all previous US conflicts, World War I showed the value they could provide as a fighting force as well as a construction force.

Despite the widely held notion that military engineering in World War I was largely confined to survivability and countermobility US engineers performed primarily *mobility* missions. The infantry units themselves emplaced the bulk of entrenchments and obstacles. Engineer units were too scarce and valuable to dig trenches and string wire.[33]

The first US ground troops that saw combat in the war were railway engineers in the Battle of Cambrai. In preparation for the attack the US 11th Engineers constructed and maintained railroad lines to the forward area. These lines proved vital for rapidly moving tanks to the front and for supplying the operation. US Army engineers, in close

[31] Bond - *The Engineer in War*, 13
[32] Davis, Franklin M. Jr. and Jones, Thomas, ed., T. *The U.S. Army Engineers – Fighting Elite* (New York: Franklin Watts, Inc, 1967), 105-106
[33] Ibid

cooperation with British maneuver units, rapidly moved four hundred thirty-eight tanks to the front for the first major armored attack in history.[34]

Beginning with the Meuse-Argonne offensive of 1918, the 4th Engineer Regiment (4th Division) opened and maintained roads through no man's land. Despite heavy direct and indirect fire the engineers kept the road open and sustained the allied offensive. There are many other historical examples of the contributions of US engineers in World War I. The effective use of military engineering not only enabled tactical victories but also facilitated the operational and strategic mobility – not only of combat forces but also of logistics - which eventually won the war. This method of robust, reliable logistical support has become the standard for how America wages war. A key to this success was, as Bond described, having engineers "intimately connected with the movements and operations of the force".[35]

This tightly coupled engineer support of the combat forces, and the complete integration of engineers into the scheme of maneuver, has proven time and again to be a recipe for success.

The close cooperation with maneuver forces that engineers enjoyed throughout World War I was diminished slightly at the start of the Second World War. The years of decline and neglect in the interwar period took their toll as the Army clung to obsolete weapons and tactics while technology advanced drastically. More dramatically the manner in which the forces were organized and trained was geared more towards "economic efficiency and conservation of scarce resources" than tactical and operational

[34] ibid. 107

[35] Bond - *The Engineer in War*, 13

necessity. Though combat divisions retained their engineer regiments in the interwar period the engineers, if they trained at all, trained in a vacuum. Rarely did the Army engage in large-scale, combined arms training. Proficiency with the rifle and bayonet and the efficacy of the "headlong attack" were the basic doctrinal beliefs. At the onset of GHQ Maneuvers in Tennessee in early 1941, many regular units, and virtually the entire National Guard, completely lacked engineer (and many other combat support/combat service support) headquarters. Because of severe manpower and financial shortages they were simply closed down or minimally manned.[36]

The outcome of this neglect, and the failure of the US military to adapt to change, became all too evident when US forces met the Axis in North Africa in 1942.[37] At the time of Pearl Harbor the US Army had 1,638,000 men in uniform but only a single division with all of its supporting combat support and combat service support units on a war footing.[38] There simply was not enough time to train the rapidly-expanding army properly. Combat support and combat service support units were virtually thrown together and assigned to combat formations in the 11th hour.

When the 1st Armored Division and 34th Infantry Division deployed to North Africa they did so effectively as ad-hoc organizations; not as well-trained, combined arms organizations.

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[36] Blumenson, Martin. "Kasserine Pass, 30 January-22 February 1943." *America's First Battles: 1776-1965* (Lawrence: University of Kansas Press, 1986), 227-237

[37] Cohen, Eliot A. and Gooch, John, *Military Misfortunes: The Anatomy of Failure in War* (New York: Random House Vintage Books, 1991), 133-161.

[38] Ibid. 237

At the Kasserine Pass both natural and manmade obstacles disrupted US counterattacks. II Corps had adequate engineer support but the lack of training and cooperation between the engineers and maneuver units made both ineffective.

Though some engineer units, such as the 16th Engineers of the 34th Infantry Division, performed brilliantly, their efforts were not coordinated or integrated into the overall operation.[39]

The bitter lessons of the North African Campaign led to changes in combined arms organization and training. This included increased numbers of engineer battalions in the combat divisions and emphasis on combined arms breaching of obstacles.[40]

US Army engineers were again closely-integrated into maneuver formations and enjoyed increasing success until the end of World War II but the same bitter lessons would be forgotten and learned once more when Task Force Smith deployed to Korea in 1950.

Again because of budget constraints and lack of attention by the American government and people, the occupation army in Japan deteriorated into an ineffective fighting force. Combined arms training for US forces was virtually impossible in post war Japan due to lack of resources, a "police force attitude", and limited training areas. Once again the ad-hoc unit that America deployed in the opening days of conflict would suffer from a complete lack of unit cohesion and combined arms integration. This time the result was a disaster equal to or greater than the Kasserine Pass. When Task Force Smith made its valiant stand against North Korean tanks on the morning of 5 July they

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[39] Ibid. 257-259

[40] Greenfield, Kent, T., Palmer, Robert, R., and Wiley, Bell, I., *The Organization of Ground Combat Troops, The Army Ground Force, U.S. Army in World War II.* (Washington, DC: Government Printing Office, 1948), 428-430

were not completely dug in and did not have a single antitank mine in place. In fact they hadn't brought a single antitank mine to Korea.[41] North Korean tanks rolled effortlessly though the beleaguered unit despite a heroic defense. The rest is history that inspired a very relevant but briefly used slogan for the US Army - "No more Task Force Smiths!"

Despite their failures, the commanders of the 24th Infantry Division and Task Force Smith were not fools. They were trained, experienced and battle-hardened leaders. They had learned the hard lessons on the battlefields of World War II. Their organizations were not trained or set up for success. Major General William F. Dean and Lieutenant Colonel Charles B. Smith were combined arms experts and did their best to overcome the entropy engulfing the occupation army at the time but they lacked the power or understanding to change their organizations before they were thrown headlong into combat.[42] Their failure illustrates many things but it especially illustrates human limitations. No matter how accomplished the commander, no one can be expected to be an expert in every aspect of military operations or to be able to plan for and predict every eventuality. This is one reason why tight combined-arms integration (of all combat functions) has so often proven critical to success.

The integration of engineers into combat formations reached its climax at the end of the 20th century. In Operation Desert Storm each heavy maneuver brigade had its own combat engineer battalion in direct support. Combat engineer groups managed corps level engineer units that supported each of the combat divisions. These groups were either in direct support of or attached to the divisions they supported. Combat divisions

[41] Flint, Roy K. "Task Force Smith and the 24th Division: Delay and Withdrawal, 5-19 July 1950." *America's First Battles: 1776-1965* (Lawrence: University of Kansas Press, 1986), 278

[42] Ibid. 274-275

in the Gulf War enjoyed a level of engineer support never seen before in US Army history. Corps and echelons above corps engineer units provided a robust capability throughout the theater. Engineer units were closely integrated into the operation at all levels and this contributed to the stunning battlefield success. Though there were still many problems to solve and bugs to work out of the organization, this level of support practically guaranteed mobility for US forces[43]. The enemy mine threat was clearly identified and easily overcome. Successful operational mobility in Desert Storm was not tied to breaching obstacles as most military leaders envision. The key was opening and maintaining supply routes through the desert to move the mountain of logistics that supported the combat forces. Supply routes were quickly established and kept open despite the most adverse conditions. This probably contributed to the outcome of the operation as much as any other factor.[44]

It has been said that the victory in the Gulf War was won on the mock battlefields of the National Training Center and in the halls of Fort Leavenworth.[45] This is particularly true in regards to the employment of engineers. Mock battles at the NTC proved time and again the necessity of close integration between engineers and maneuver forces both on the offense and the defense.[46] These lessons were validated on the sands of Iraq and Kuwait.

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[43] Swain, Richard, *'Lucky War': The Third Army in Desert Storm* (Fort Leavenworth, KS: US Army Command and General Staff College Press), 243
[44] Ibid. 332
[45] Clancy, Tom, *Into the Storm: A Study in Command* (New York: G.P. Putnam's Sons, 1997), 117-118
[46] Scales, Robert H., *Certain Victory: The US Army in the Gulf War* (Washington DC: Office of the Chief of Staff, US Army, 1993), *21-22*

<u>Bond's Second Principle</u> - "Engineer operations are essential to increase the offensive or defensive powers of the combatant forces and limit or decrease those of the enemy".

When most people think of the missions of engineers in support of maneuver forces they tend to think of preparing fortifications and emplacing mines and obstacles. This has been a traditional role for engineers. It extends back to the earliest periods of armed conflict. Early military engineers built fortifications and other engineers (sappers and miners) attempted to breach them. While these missions, formally classified as survivability and countermobility, are of secondary importance to mobility they are still critical to success on the modern battlefield. As masters of the terrain, engineers attempt to use the terrain as a weapon against the enemy by combining manmade and natural obstacles.

While the emphasis of modern forces must be on maintaining mobility, we cannot overlook the preservation of combat power afforded by applying various forms of protection. Field fortifications are still very effective in many circumstances, and the ability to rapidly emplace them is critical to maintaining the survivability of a modern force.

Even our most recent experience in Afghanistan shows that well constructed field fortifications can greatly aid defenders in complex terrain. Despite the huge technological advantage that US forces held over al Qaeda and the Taliban, their defensive works greatly complicated US target acquisition and reduced the effectiveness of weapons systems – including precision guided munitions. While US special operations forces (SOF) knew they faced an interconnected trench system with the enemy

somewhere within it, cover and concealment were good enough to prevent the location and destruction of individual fighting positions.[47] At the ancient Qala-e-Gangi fortress, renegade prisoners in small underground chambers survived pounding from entire ammunition payloads of multiple AC-130 gunships and no fewer than seven 2,000-pound JDAMs.[48] Even archaic fortifications can still frustrate attacks from the most high-tech weaponry.

The burden of constructing fortifications, or locating and reducing them, will undoubtedly still fall upon a great many soldiers in the foreseeable future.

<u>Bond's Third Principle</u> - "The most important special duties of engineer troops in the mobile army are: Military Reconnaissance, Sketching and Surveying"

It is a universally accepted notion that the side with superior knowledge of the enemy and terrain will enjoy a distinct advantage in warfare. Though our emerging doctrine is centered on information superiority the understanding of the value of information is a timeless principle of war. In his book *Scouting, Patrolling and Musketry*, P.S. Bond wrote that, "the collection, study, interpretation and distribution of information are the duties of the intelligence service of the army. Every possible means of collecting information is utilized and every possible source is investigated."[49] In *The*

[47] Biddle, Stephen, *Afghanistan and the Future of Warfare: Implications for Army and Defense Policy.* (Carlisle, PA: Strategic Studies Institute, US Army War College, 2002), 27-28
[48] Ibid. 35
[49] Bond, P.S., *Scouting, Patrolling and Musketry* (Baltimore: The New Military Library, 1923), I

Engineer in War he makes the point that the collection, study, interpretation and distribution of terrain intelligence "will fall especially upon the engineers".[50]

Mapping, charting, geodesy and the analysis of terrain have officially been missions of the engineer regiment since the Corps of Topographical Engineers merged into the Corps of Engineers just prior to the Civil War.[51] The information age and dramatic advances in technology provided by aerospace-based systems and computers have increased the visibility of topographic (now referred to as "geospacial") engineering but it has long played an essential role in US military operations. The line between true geospacial engineering, typically associated with topographic engineer units, and engineer reconnaissance, normally performed by combat engineers, has never been a distinct one. The disciplines of cartography, terrain analysis and engineer reconnaissance are interdependent and overlapping at all levels of military operations. With advances in technology the line is becoming more indistinguishable and practically irrelevant as technology now enables combat engineer units to perform increasingly detailed cartographic and terrain analysis missions. The element that remains unchanged is, as Bond pointed out, the requirement for trained personnel to interpret the data.[52]

CHAPTER FOUR

Assured Mobility vs. Bond's Principles - an analysis

As the Army embarks on its latest quest to transform itself, the doctrine writers, visionaries and outright speculators are pondering the key capabilities that the Objective

[50] Bond - *The Engineer in War*, 114
[51] *The History of the US Army Corps of Engineers* (Washington, DC: US Army Military History Institute, 1986), 30-31
[52] Bond - *The Engineer in War*, 114

Force must have. One capability that most agree on is mobility. Ideally, Units of Action (UA) should be able to maneuver wherever and whenever they need to in the battlespace. *Assured mobility* is the doctrinal concept that prescribes this capability.

In Search of "Assured Mobility"

Assured mobility is defined as, "actions that guarantee the force commander the ability to maneuver where and when he desires without interruption or delay to achieve intent".[53] The doctrine writers assume that the future operating environment will include intense and dynamic mine and other obstacle threats, and that potential enemies will seek to slow and disrupt our operations while maintaining standoff. According to the Objective Force O&O, Assured Mobility will allow us to overcome these threats by applying the following principles (called "imperatives"):

1. Develop the mobility common operational picture (COP).

2. Select, establish and maintain operating areas.

3. Attack the enemy's ability to influence operating areas.

4 Maintain momentum and mobility.

The application of these imperatives, through their supporting systems will (in theory) enable Objective Force commanders to *see first*, *understand first*, *act first* and *finish decisively*.[54]

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[53] US Army Field Manual 3-34, *Engineer Operations (Draft)* (Washington, D.C.: Department of the Army, 2002 [final TBP 2003]), 11

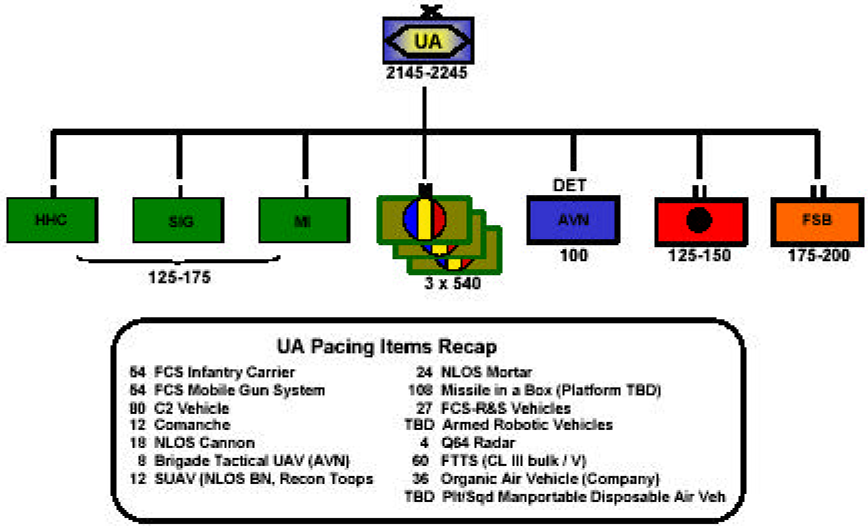
[54] US Army Training and Doctrine Command, TRADOC Pamphlet 525-3-90/O&O, *The United States Army Objective Force: Operational and Organizational Plan for the Maneuver Unit of Action* (Ft Monroe, VA, US Army TRADOC, 2002), 50-52

The two central imperatives ("select, establish and maintain operating areas" and "attack the enemy's ability to influence operating areas") are familiar concepts. They involve a myriad of implied tasks such as route and area clearance, employment of protective obstacles and reconnaissance and surveillance operations. But armies have both understood and lived by these imperatives (though the methods for achieving them have changed) since the dawn of organized warfare. The concepts of developing mobility COP and maintaining mobility and momentum incorporate concepts that are more complex.

Analysis in this chapter focuses on those two imperatives and on the organization and means proposed to achieve them.

A New Organization with "Embedded Capabilities"

The architects of transformation seek to provide Assured Mobility through a combination of embedded systems (mostly at the UA level) and supporting engineer units. A significant change from current doctrine and organization is the elimination of engineer soldiers from the Unit of Action. The UA will count on its embedded systems and, if required, support from engineers within the Unit of Employment (UE) to maintain mobility.



[55]

Embedded systems in the Objective Combat Vehicle will provide the capability to[56]:

- Provide standoff detection of obstacles and mines.
- Mark mines and obstacles.
- Neutralize mines, improvised explosive devices (IED) and unexploded ordinance.
- Cross gaps < 4.0 meters.
- Protect crews from antipersonnel mines and off route antitank mines.

> ***"Duty with the mobile army is the prime function of engineer troops."***
> ***P.S. Bond, <u>The Engineer in War</u>***

Engineers in the Unit of Employment (UE) will perform mobility tasks that exceed embedded capabilities as well as the general support mobility, countermobility, survivability, geospacial and field force engineering tasks for the UE.

[55] Unit of Action Organization chart from *TRADOC Pamphlet 525-3-90/O&O*, 50
[56] Ibid. 139-142

P.S. Bond would certainly agree that Assured Mobility is a fundamental requirement for the Objective Force. As early as 1916 he identified mobility as the most critical function for engineer troops. Bond truly advocated that engineer organization, training and equipment should be primarily based on providing mobility even if it meant reduced capability to perform other, more visible missions such as construction of facilities.[57] Military thought seems to continue to hold to this principle despite technological advances and the multitude of other engineering missions on the modern battlefield.

Where Bond would certainly take issue with our emerging doctrine and organization is the exclusion of engineers from the Unit of Action. Bond emphatically stated time and again that "engineer troops should be with the combatant forces at the front" and that "their duties will be *intimately connected* (emphasis added) with the movements and tactical operations of combatant forces."[58] When engineer forces from the UE will be task organized to support the UA "as required" they can never be as fully integrated into tactical operations as organic engineers could. JFC Fuller made this assessment in 1932. Fuller wrote, “The Royal Engineers, I feel, should be brought into far closer touch with the mechanized arms than they are today.”[59] Many soldiers would probably agree that the US Army’s own experience with engineer reorganization since Desert Storm has validated this. Engineer units with habitual relationships to maneuver units are an integral part of the commander's scheme of maneuver.

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[57] Bond - *The Engineer in War,* 13-14
[58] Ibid. 13
[59] Fuller, J.F.C. Major General, *Lectures on FSR III [Operations Between Mechanized Forces].* (London: Sifton Praed & CO., LTD., 1932), 22-23

They develop an intimate working knowledge of the strengths, weaknesses and idiosyncrasies of their supported maneuver units unlike any that units assigned "as required" could ever get. Most importantly, integrated engineer units are part of the planning process for maneuver units. While forces from another echelon may be brought in to help develop plans, history shows that their integration is never as complete as that of organic (or habitually associated) forces. We trust our own people better than outsiders. This is simply human nature and no amount of technological wizardry is likely to change it. P.S. Bond's writings (like Fuller's) show that he clearly understood this aspect of engineer employment. The exclusion of engineers and other specialist troops certainly represents a compromise to gain a smaller, lighter force. We hope to use embedded systems to make up for this lack of capability. This compromise could place future forces at great risk.

> ***"Therefore the engineer places his chief reliance on the most mobile and adaptable of all machines - man himself."***
> ***P.S. Bond, The Engineer in War***

The fact that the objective force architects envision a requirement for engineer support from the Unit of Employment shows that they do not expect embedded systems to do everything. Will embedded technology, even with decades more innovation, be able to stand up to the enormous complexity of the future battlefield? The enemy has an enormous range of options, ranging from the employment of Stone Age technology to off-the-shelf "wonder gadgets", to counter our technological advantage. Nowhere is this more extreme than in mobility/countermobility and battlefield engineering.

Land mines have been the poor man's asymmetric weapon of choice for a very long time. Employing mines of all shapes, sizes and capabilities is relatively easy for most forces. Chechen forces in Grozny demonstrated this very well by employing over 120,000 mines just in the span of several months. These mines were not all simple pressure-fused varieties. They included many ingenious command-detonated and nearly undetectable improvised devices.[60] No matter what technology we deploy, the threat will adapt and seek to overcome it. The sheer scale of the Chechen mining effort in Grozny also illustrates how difficult it would be for the limited, embedded systems in a brigade-sized UA to deal with the threat. Russian forces in Grozny learned that engineer support "as required" can quickly become "all the time". Unfortunately it does not look like we are designing our objective force to provide this capability all the time.

The Mobility Common Operating Picture (COP)

Just as our emerging doctrine states, “seeing first and understanding first” are critical to attaining and maintaining assured mobility.[61]

P.S. Bond clearly understood the value of information and stated what he believed to be the engineers' leading role in military reconnaissance. He also clearly articulated that the intelligence branch had the ultimate responsibility for management of information.

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[60] Thomas, Timothy L., Foreign Military Studies Office, “Grozny’s January Battles”, in a guest lecture to the School of Advanced Military Studies, Urban Operations Elective (Fort Leavenworth, KS, 22 January 2003)

[61] *TRADOC Pamphlet 525-3-90/O&O*, 50-52

The information environment encompasses virtually every aspect of military operations. It has such complex and interdependent relationships that it is difficult to determine where one organization's responsibilities end and another's begin.

Clearly there must be a close relationship between military intelligence and geospacial engineering but there must also be a relationship between these elements and what is traditionally considered engineer reconnaissance. All three disciplines are interrelated and interdependent.

> ***"The modern game of war then is played upon a map."***
> ***P.S. Bond, The Engineer in War***

Whether they are printed on paper or displayed digitally on a screen, maps remain as a fundamental building block for planning and executing military operations. Engineer terrain analysts have long had a close association with Army G2 staffs but the engineers lack trained specialists in other areas of intelligence.

They also lack the means to integrate more closely into the intelligence collection and analysis apparatus. Conversely, the military intelligence corps lacks personnel who specialize in engineer intelligence. With the vast amount of analysis required in today's worldwide threat environment few military intelligence professionals can have very detailed knowledge about obstacles, engineer capabilities and equipment. Threat engineer capabilities and the obstacle situation should always be carefully considered during Intelligence Preparation of the Battlefield (IPB).[62]

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[62] Glenister, Cynthia, "The Engineer Intelligence Process" ", *Engineer: The Professional Bulletin of Army Engineers*. March 1997, [article on line]; retrieved 2 February 2003 from <http://call.army.mil/products/trngqtr/tq2-98/s2.htm

There is currently a noticeable gap between the geospacial intelligence world and that of combat engineer reconnaissance in spite of the fact that both of these missions belong to the engineer regiment. Though most engineer soldiers are trained in engineer reconnaissance there are not any specially trained or equipped units to carry out the mission. The same combat engineers that are required for mobility and survivability are called upon to conduct engineer reconnaissance. With the huge number of requirements on engineers the reconnaissance mission, and training for it, is usually a low priority.[63] Finally, staffs at the tactical and operational levels often do a poor job integrating engineer reconnaissance and geospacial intelligence. There are several reasons for this but one of the chief concerns of the engineer branch currently is the lack of a designated "Engineer Intelligence Officer" to coordinate this fusion.[64]

Planners must remember that advanced sensors cannot do everything – especially without skilled and highly trained personnel to interpret the data. Despite the most advanced surveillance and target acquisition technology, the earth's surface remains a very complex environment with an abundance of natural and manmade cover and concealment. At the beginning of Operation ANACONDA in March 2002, an intense pre-battle reconnaissance effort focused every available ISR system on a tiny ten-by-ten kilometer battlefield. Yet fewer than fifty percent of all the al Qaeda fighting positions were discovered until ground forces came into direct contact with them. In fact, most of the fire received by US forces in ANACONDA came from unanticipated positions.[65]

[63] Pasgovel, Matt., "Route Reconnaissance: A Lost Art", *Engineer: The Professional Bulletin of Army Engineers*. (Washington DC, US Government Printing Office, April 2000), 42-49
[64] Minutes from the Countermine ICT Council of Colonels Meeting (Fort Leonard Wood, MO. 13-15 November 2002), 2-10
[65] Biddle - *Afghanistan and the Future of Warfare*, 28-29

To realize the goal of a Mobility COP we have to create a structure to make it happen. Modern and future command and control and ISR systems will help, but we will need trained and dedicated people in the right positions to collect, analyze, interpret and distribute the information. These people should have an intimate knowledge of the plans and operations they are supporting. They must be integrated; not isolated. Just as the maneuver arms still recognize the need for ground reconnaissance despite the increasing use of advanced sensors such as unmanned aerial vehicles, the engineers will also need trained soldiers capable of performing engineer reconnaissance. All of this needs to be synthesized into an intelligence system that interconnects with the traditional, mainstream intelligence systems.

Maintaining Mobility and Momentum

Mines are currently the primary concern for engineer doctrine writers, trainers and planners but mines are not the only problem. River crossings, like mines, are operations that bear serious consideration and preparation. But many other natural and manmade obstacles can also have dramatic effects on mobility.

The Battle of Mogadishu in 1993 provides an interesting example of what enemies using only simple tools and techniques can do to deny mobility to US forces. It could be argued that TASK FORCE RANGER assumed they had assured mobility, provided by their aircraft, when they flew into Mogadishu to apprehend key Somali leaders. This assumption was quickly invalidated by Somali gunmen who used rocket propelled grenades (RPGs) to counter TF RANGER's primary mobility asset - UH-60 Blackhawk helicopters. The downing of two Blackhawks compromised the entire mission and eventually led to the fierce engagements that cost the lives of 18 Americans.

Ground convoys, which were supposed to extract TF RANGER and their prisoners, were employed as a backup measure but were severely delayed by simple roadblocks made from debris, junked cars and burning tires. Despite the fact that ground convoys could often see the crash sites they could not necessarily get to them. This was in part due to deliberate roadblocks constructed by the Somali gunmen.[66] Even though the US Army has engineer assets that could have easily breached the roadblocks, no dedicated engineer assets were in support of TF RANGER. The ground convoys had a very good "Mobility COP", provided live by overhead command and control aircraft, but they did not have the means to breach any encountered obstacles. The ground convoys could only attempt to bypass encountered obstacles that often lead them into ambushes. For this reason it is often better to breach than to bypass. Though the warring clans in Somalia used land mines extensively, they played virtually no role in this battle. To focus all of our efforts on countermine technology could mean we are neglecting other very serious threats.

"If I had 10 pontons, I should have captured 10,000 wagons, beaten Prince Schartsenburg in detail, annihilated his army and closed the war; but for want of proper means I could not cross the Seine." - Napoleon, 26 January 1814

The preceding example illustrates that, while information may be vital to success, that information alone is not enough. Forces must have the ability to adapt quickly to the information received and the means to act on it. P.S. Bond stated this repeatedly

[66] Bowden, Mark, "Black Hawk Down: An American Story", *The Philadelphia Enquirer* [article on line]; Retrieved 12 February 2003 from < http://inquirer.philly.com/packages/somalia/dec01/default01.asp

throughout his writings. As Bond pointed out, maintaining mobility and momentum are largely reactive processes.[67] Better, more complete information can certainly help us predict requirements but the key to success is having the right assets close at hand to deal with situations as they arise. This means having assets in the organization (whether organic or task organized) and carefully planning their employment. Regardless of how the objective force is organized and equipped it must still maintain sufficient mobility assets to deal with the complex array of obstacles that an adaptive enemy can employ and to deal with the many challenges that nature itself presents.

The probability of future operations in urban environments is increasing. Given this reality it is increasingly likely that the US Army will find itself in situations similar to Mogadishu, 1993. As proposed, the embedded systems in the Unit of Action do not have the capability to breach the types of obstacles the Somalis used effectively against TF RANGER.[68]

CHAPTER FIVE

CONCLUSION

Warfare presents many complex environments. The future of warfare will undoubtedly be one of increasing complexity. Weapons, communications and transportation technology continues to advance. Military forces continue to develop, alter and refine their doctrine and tactics to coincide with technological advances.

[67] Bond - *The Engineer in War*, 20-24
[68] *TRADOC Pamphlet 525-3-90/O&O*, 139-150

Time and time again battlefield experiences continue to show that human beings are still, as P.S. Bond wrote in 1916, “the most mobile and adaptable of all machines”.[69] Recent combat experiences have once again sharply illustrated the importance of having soldiers on the ground. While mainstream military modeling and analysis has predicted increasing lethality and mounted or aerial warfare, operations against the Taliban and al Qaeda showed that the enemy can still present great difficulty when deliberately and skillfully dug in. Future enemies will no doubt employ similar tactics if the terrain and situation permits.

In his recent monograph, Stephen Biddle of the Strategic Studies Institute points out that the most effective way to deal with these tactical situations is to maintain and deploy a combined arms mix with tightly integrated fire and *ground* (emphasis is the author’s) maneuver. As our firepower and accuracy increases with advances in precision-guided munitions our opponents will continue to seek cover in increasingly complex terrain. If we care about effectiveness we must organize, train and deploy forces that can adapt to and operate in this complex terrain - not be hindered by it. [70] The demand for combat engineering assets and expertise is only likely to increase.

Experiences in civil engineering show similar trends. With the increasing complexity of design and construction, brought about by information technology and advanced building materials, the demand for engineers is increasing rather than decreasing. Machines may make much of the labor easier and faster but they do not decrease the need for judgment and decision. Until artificial intelligence takes a

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[69] Bond - *The Engineer in War*, 25
[70] Biddle, 50-57

gargantuan technological leap we will still count on humans to make the critical decisions.

To win future conflicts the US Army must develop and use the most cutting-edge technology but we must also train and employ excellent soldiers. We must develop soldiers who are able to effectively use the technology available to deal with the increasing complexity of military operations.

Since the time P.S. Bond wrote *The Engineer in War*, US Army engineers have been the masters of the complex environment of the mobile, mechanized battlefield. Bond, like his contemporaries J.F.C. Fuller and B.H. Liddell Hart had the vision to see the impact technology would have on mobility and maneuver. Bond in particular had a clear understanding of the importance of junior leaders and leadership development. The evidence of this can be found in his many works on the subject. His ideas and the concepts the Army employed through The Gulf War, helped ensure that combat engineer soldiers were trained and available to assure mobility no matter what the situation or the resources available. Engineer soldiers made things happen because they were able to adapt quickly to complex situations. The technology was secondary. It was a tool employed by resourceful, trained experts.

The objective force demands assured mobility. Architects of the emerging doctrine now believe that technology can replace expertise at the lowest organizational level (Unit of Action). They advocate that increased technology can also enable physical separation of some combat functions without actual separation. Command and control systems will bring them virtually together. The result of this is the disintegration of engineers from the Unit of Action and a large-scale reduction in their capabilities.

This approach runs counter to established, historical principles of war and puts our forces at potentially great risk.

While the technology may be intended to reduce risks, it is, "both a blessing and a curse", as Henry Petroski put it.[71] New concepts for fighting may easily overcome ninety-nine percent of the challenges presented by future enemies but the remaining one percent could cause catastrophic results. Without trained, competent people close-at-hand to deal with complexity and change the astute enemy can always come up with ways to defeat us.

Assured Mobility - The Concept is Valid

If we intend to transform the Army and develop the Objective Force in the ways we are currently proposing (lighter, knowledge-based, mobile yet lethal, etc.) then assured mobility is an imperative. An information-based approach, which leverages advanced technology to detect and overcome obstacles, seems to be the best way to achieve this end. One aspect of terrain is that it is relatively constant. Unlike the enemy situation, which is constantly changing, terrain changes relatively slowly and predictably most of the time. Natural obstacles may shift somewhat over time, and man made features may alter the terrain, but these changes are relatively slow and methodical. The enemy may influence these changes more rapidly, through the use of mines and other obstacles, but even these changes in the battlespace are predictable and detectable. Remote sensing and geographic intelligence systems (GIS) currently provide the most complete and detailed information of the Earth's surface that we have ever enjoyed. For these reasons an information-based approach will succeed as long as trained people use

[71] Petroski , 197

good judgment. Training is essential so that these individuals know what to look for and how to ask the right questions. These people must not only know how to use the tools provided but must also have a clear understanding of the battlespace, the concept of operations and the capabilities of friendly and enemy forces.

Mines will continue to be a significant threat to mobility. Focusing on developing systems to detect and overcome mines, and embedding this capability into combat vehicles, is a good idea. Anything that can increase survivability and capability against these threats will pay some dividends but we must never forget that there is no single, simple solution.

Proposed Implementation is the Problem

As currently drafted, the Objective Force doctrine proposes to replace terrain and mobility experts (combat engineers) with automated, embedded systems at the Unit of Action (UA) level. The obvious cost is a significant loss of capability at the tactical level. The higher order effects have a larger impact. Echelon's above division (EAD) engineers may not be responsive enough to meet immediate needs.

The exclusion of engineers from the Unit of Action removes them from the "brigade fight". The result of this will be engineer officers and soldiers with limited first hand experience in battalion and brigade operations. Training and task-organization can partially compensate for this, but not as well as having engineers integrated into these units. Without this experience engineers in the Unit of Employment will not have a detailed understanding of the forces they are expected to support.

Another cascading effect of this organization change is the displacement of mobility and survivability responsibilities to higher-echelon engineer units (UE and the

current corps-level / “UE2” units). This violates the time-honored principle of solving problems at the lowest level. This will increase the mission load on units that are already taxed to capacity and considered somewhat unresponsive to the tactical commander.

Recommendations

1. Power Down: Give the Unit of Action Robust Engineer Capability and Concentrate on Higher Echelons Later.

Designers for the objective force appear to be taking a bottom up approach. They are focusing first on the Unit of Action, then the Unit of Employment and then higher echelons and so on. They seem to loose sight of this when designing the engineer organizations within the objective force. If anything, the trends in engineer effort are shifting to lower levels. Examples of this are combat heavy engineer battalions, which have traditionally been theater-level assets. For years they have been increasingly employed in support of tactical missions. Another example is the organization of an engineer battalion with each heavy maneuver brigade instead of a company. In light of this evidence, the Objective Force approach to engineer support appears to be somewhat backwards. If anything, we should maximize the engineering capability in the UA first then develop it at higher echelons.

The focus should be on personnel, not necessarily on the equipment systems.

> An option is to integrate one or two sappers into each infantry squad, and a “maneuver support officer” into the company, in the same manner as a fire support officer and fire support team.

A tactical engineer force does not have to compromise the mobility and deployability we are looking for in the UA. They can ride in essentially the same combat

vehicles as their infantry counterparts – possibly with minor modifications like bulldozer blades, etc. An option, which should be seriously considered, is to integrate one or two sappers into each infantry squad, and a "maneuver support officer" into the company, in the same manner as a fire support officer and fire support team. Integrating engineers into maneuver units in the same manner as fire supporters are currently integrated seems to make sense.

How they are integrated does not matter as much as having the experts present at the point of the spear. Substituting a small number of engineers for a like number of infantrymen will not sacrifice combat power. As history clearly has proven, engineers make an effective fighting force when the situation requires.

2. Keep the Unit of Employment (UE1 and UE2) Engineers Focused More on Operational Mobility and Operational Reach – Not on Breaching.

History shows that mobility goes far beyond breaching obstacles. Examples from the two world wars through The Gulf War illustrate that obstacles and mines, while they may significantly influence some tactical fights, often have little effect on overall operations. The flow of logistics however, almost always has a profound effect.

The focus of Assured Mobility at the UA level is on detecting and overcoming obstacles and embedded systems are designed to do just that. The Unit of Action is being designed for mobility with a relatively small logistics footprint. Provided they have the expertise available for planning and execution of mobility missions, the UA should be able to deal with most obstacles with their embedded systems.

Prolonged operations will require improvements to infrastructure and more robust logistics. The Unit of Employment is really being designed with this in mind. The

engineer forces within it should be designed for this also – not a backstop for UA tactical mobility shortfalls.

Currently there is a visible gap in capability within the UE as it is currently proposed. Engineers in the UE1 and UE2 will be required to focus a good portion of their effort towards tactical mobility tasks. Since these engineers are normally the primary supporters of operational mobility we are likely to see either significantly reduced capability or requirement for more augmentation.

If the Army intends to develop the objective force in modular packages each module should have all of its combat functions self-contained. It should not have to rely on a higher echelon for most of its capability.

3. Integrate Geospacial Intelligence Specialists Into the Intelligence System at Every Echelon.

Since the mobility COP is so critical to maintaining assured mobility and the earth's surface is so complex, we need trained experts to collect and interpret terrain information. They are needed at all levels and must be integrated with both the military intelligence staff, to support IPB and collect and disseminate a COP, and with the engineers to affect the terrain where necessary. These experts should focus on manmade obstacles and threat mobility/countermobility capabilities as well.

The engineer intelligence system should be built upon the current terrain team organization with the addition of trained Engineer Intelligence Officers (EIO) at division (UE), brigade (UA) and battalion level. These elements should be organized similarly to the current Fire Support Elements.

It is essential that they manage the information and have direct access to the mobility assets to act on the information.

Instead of banking on advances in technology to replace trained experts we should develop technology as a tool. It is possible for technology to make the process more efficient and perhaps allow for a reduction in personnel. We should not however, design the organization completely around undeveloped, conceptual systems. As the Chief of Staff of the Army so eloquently pointed out, “the enduring hallmark of the Objective Force will be its Soldiers. At the heart of the Objective Force are Soldiers and leaders -- Warriors -- who will go into harm’s way to impose our Nation’s will on any adversary.”[72]

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[72] Department of the Army, White Paper, *Concepts for the Objective Force*. (Washington, DC: 1999), 5

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